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*Editorial Comment*

# Ambulatory Monitoring of Left Ventricular Function

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In this issue of the Journal, Tamaki et al. (1) describe the development of the ability to monitor left ventricular ejection fraction on a continuous basis while ambulatory patients perform various daily activities. A modified $V_5$ electrocardiographic (ECG) lead was also continuously recorded during the same activities. A transient decrease in left ventricular ejection fraction lasting ≥1 min was found on 36 occasions in 16 patients with significant coronary heart disease, but only 12 of the episodes were accompanied by chest pain or dyspnea. ECG ST segment depression suggestive of myocardial ischemia was found during 6 of the 12 symptomatic and 5 of the 24 asymptomatic episodes. In 10 of the 12 symptomatic episodes, left ventricular ejection fraction decreased 30 to 90 s before symptoms developed. These observations suggest that continuous monitoring of both left ventricular ejection fraction and the ECG for a period of several hours may allow a more sensitive identification of myocardial ischemia during normal daily activities than is possible with currently available methods.

**The "VEST".** The ambulatory ventricular function monitor ("VEST") is an extension of a probe device concept described by Wagner et al. (2) in 1976 for the repetitive measurement of left ventricular function at the bedside. They called the probe device a "nuclear stethoscope," and they and other authors (3–5) demonstrated that the nuclear stethoscope measurements of left ventricular ejection fraction correlated well with gamma camera or contrast ventriculographic measurements of ejection fraction in the same patients. The VEST device extends this concept and permits continuous measurement of left ventricular function during everyday activities (1,6,7). VEST measurements of left ventricular ejection fraction calculated from the 15 to 30 s average time-activity curves have been shown to correlate well with gamma camera measurements of left ventricular ejection fraction in normal subjects and in patients with coronary heart disease (1,6–8). Thus, it appears that Tamaki and Strauss and their colleagues have developed a noninvasive technique for the ambulatory measurement of left ventricular ejection fraction in patients.

**Clinical application.** The VEST should be an asset in the evaluation of 1) patients with chest pain of uncertain etiology; 2) patients complaining of dyspnea with effort when it is not clear whether the dyspnea might be caused by pulmonary or cardiac disease; 3) "silent" myocardial ischemia; 4) defining appropriate exercise limits for patients with underlying cardiovascular disease; and 5) providing prognostic insight in the identification of patients with coronary heart disease at risk for future coronary disease events, including death, myocardial infarction, the development of unstable angina and the need for coronary artery revascularization (9–12). It has been demonstrated previously (9,10) that patients with coronary heart disease and unstable angina with continuing ST-T wave changes at rest and during low levels of activity are at risk for future coronary events, including new myocardial infarction, death and the need for some form of coronary artery revascularization. Furthermore, Corbett et al. (11,12) have demonstrated that low level exercise testing with monitoring of ventricular function and the identification of patients with decreases in left ventricular ejection fraction or increases in left ventricular end-systolic volume, or both, identifies a subset of patients after myocardial infarction at risk for future important coronary events. The ability to measure ambulatory alterations in left ventricular ejection fraction in patients with coronary heart disease should allow one to test the efficacy of selected medical regimens and identify patients who remain at risk for future coronary events despite an adequate medical regimen.

**Future developments.** One may anticipate that there will be further methodologic developments with the VEST system. Ideally, the VEST system will ultimately have the ability to measure segmental ventricular function objectively and quantitatively. Coronary heart disease initially results in alterations in segmental ventricular function, and it seems likely that some ischemic responses to stress and exercise will be missed if only global left ventricular function is analyzed. Thus, the information provided by the VEST would be more sensitive, and possibly more specific, for coronary heart disease if segmental function is also analyzed. It will be necessary to develop methods that allow one to be more certain about the orientation of the VEST detector in regard to the optimal orientation of the detector and the left ventricular blood pool so that even slight

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alterations in position of the VEST detector with respect to the left ventricle may be identified and prevented. It will be necessary to develop VEST systems that will be applicable to patients of different body sizes and configurations. Finally, additional studies need to be done to demonstrate that the information provided by the VEST actually helps in optimal decision making regarding therapy for patients and by providing prognostic insight so that at least subsets of patients at risk for future important coronary events are identified before their occurrence.

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